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ABSTRACT

This paper describes dissertation research using cognitive psychology in the design of museum exhibit labels in an effort to increase learning and memory in museum visitors. Three studies focused on factors affecting whether or not using a question (instead of a statement) as a title on a museum exhibit label would increase the visitor's memory of the information presented in the label text. In the experiments, labels accompanying the bird dioramas at the Bell Museum of Natural History at the University of Minnesota were rewritten. The college student subjects visited the museum at their leisure and were tested on the content of the experimental labels. Evidence was found that using questions from exhibit titles increased learning. (EH)

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Label Length and Title Type as Determinants in Visitor Learning

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Abstract

This dissertation applied concepts from cognitive psychology to the design of museum exhibit labels in an effort to increase learning and memory in museum settings. A series of three studies focused on factors affecting whether or not using a question (instead of a statement) as a title on a museum exhibit label would increase the visitor's memory of the information presented in the label text. The first study is being published separately by Litwak, Bielinski, & Samuels. The other two studies form the basis of the dissertation. In all three experiments the labels accompanying the bird dioramas at the Bell Museum of Natural History at the University of Minnesota were rewritten. Subjects (college students) visited the museum at their leisure. At the end of their visit they were surprised with a multiple choice test (dependent variable) on the content of the experimental labels (independent variable). Evidence was found that questions increased learning.

Introduction

Museums are not often optimal learning environments. They can be distracting settings, overloaded with information and crowded with visitors seeking to fulfill personal and social agendas. Museum professionals lament the fact that many visitors spend relatively little time at each exhibit component and usually only stop at a small portion of the displays in the museum. Under these conditions it is not surprising that the information presented in the exhibits does not find its way into the long-term memory of the visitors. To truly learn and remember new material, the learner must focus on, elaborate, organize, and rehearse the information. Visitors must form personally meaningful associations with the exhibit content and link it to their pre-existing schemas. This takes time and energy and often fails to occur in a museum setting.

In an attempt to combat these overwhelming odds, museums employ a variety of little psychological tricks to catch and keep visitors' attention. One of these tricks is to pose questions to visitors on the exhibit labels. The philosophy behind this method is that once the visitors' curiosity is peaked, they will read the label and learning will naturally follow (Screven, 1986, 1992; Rand, 1985). Screven and Hirschi (1988) found that adding a question to an exhibit label increased time spent at the exhibit from 6.6 seconds to 95 seconds. However, no study to date has sought to measure the increase in learning that results from the addition of the question.

Studies in classroom settings, by contrast, have been much more focused on how questions can increase learning. While classroom teachers and textbooks do sometimes use questions to pique curiosity, questions are more often used to guide the cognitive processes of the students. While most studies to date have focused on teacher-student discourse, headway has been made in understanding the role of questions in text. Leonard (1987) found that students who read texts with questions at

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the beginning of each paragraph scored significantly higher on achievement tests than did the students who read the same text without the questions. Friedman (1981) found that inferential questions inserted in the text at the end of paragraphs prompted higher achievement than literal questions.

In applying these classroom findings to a museum setting we need to explore two factors: "What *type* of question, when posed on a label, facilitates the most learning in a museum setting?" and "Under what conditions do we encounter increased learning as a result of the new labels?" The following three studies were designed to explore these questions.

Study One

Goals

The goal of Study One was to compare the teaching efficacy of three different types of questions that could be posed on the labels: explicit, implicit, and scriptual. This typology looks at how the question is answered in the label text for the visitor. Straight-out, word-for-word answers are called explicit. Answers that are alluded to but must be pieced together by the visitor are called inferential. Questions that ask about the experiences and opinions of the visitors and thus are not answered in the text are called scriptual. Our hypothesis was that the implicit questions would produce better recall of the information on the labels because they force the visitor to manipulate the information more thoroughly in order to arrive at an answer.

Methods

Site and Materials. The experiment took place in the Bird Hall at the Bell Museum of Natural History located on the University of Minnesota main campus. The labels accompanying the eight largest dioramas in this gallery were rewritten to focus on the most prominent species of bird in the display. Each of the experimental labels consisted of a title, a simple text presenting 3-4 facts about the chosen species of bird in the diorama, and a line drawing of the target bird. The average label was 50 words long and was written at a 7th grade reading level. The text and questions were created by the author and edited by the curators of the Bell Museum. Labels were laser printed in New York font, 24 point for the text and 36 point for the titles, on 8.5" x 14" white paper and inserted into backlit panels of the same size built-in along side the dioramas.

The experimental conditions were created by manipulating the type of question which appeared at the top of the labels. The text and drawing for each label remained the same for each condition. A new round of experimental labels was installed each week, the order having been determined by a random drawing. The four experimental conditions were:

Week One:	Explicit Question	(Answer stated explicitly in the label text)
Week Two:	Implicit Question	(Answer implied, not directly stated)
Week Three:	Scriptual Question	(Answer not stated or implied)
Week Four:	Statement Title	(No question, only the name of the bird)

For example, the text for the exhibit with the Burrowing Owl was:

> The Burrowing Owl builds its nest underground. These owls could dig their own burrows, but they usually use the abandoned den of a prairie dog or pocket gopher. When a predator approaches, the Burrowing Owl dives into its underground nest.

The experimental titles were:

Explicit Question: Could a Burrowing Owl dig its own burrow?
Implicit Question: Are burrows a safe place for Burrowing Owls to hide?
Scriptual Question: Would you like to live in an underground nest?
Statement Title: Burrowing Owl

A 24 item multiple choice quiz was then created to test the subjects' memory of the facts presented on the labels. Each label text contained three facts: one that was the answer to the explicit question, one that was the answer to the implicit question, and one additional fact. Thus three multiple choice questions could be created for each of the eight labels. This quiz was informally pretested on several small samples of graduate students and revised until each response foil for each question was endorsed by approximately one quarter of the respondents.

A second instrument was created to learn about the behaviors and affective responses of the subjects that might have had an impact on their memory of the exhibit labels. These eight items, which were administered before the quiz, asked the subjects to rate their opinions or behavior on a five point scale (Not at all...A Little...Very much; First...Middle...Last; etc.)

1. How much did you enjoy your visit at the Bell Museum today?
2. How much did you enjoy the large, bird dioramas in particular?
3. How many of the labels at the bird dioramas did you actually read?
4. How interesting and entertaining were the labels at the bird dioramas?
5. How much do you feel you learned from the labels at the bird dioramas?
6. When during your visit did you view the bird dioramas?
7. Did you visit the museum today alone, or with a friend? (yes/no)
8. Had you ever been to the Bell Museum before today? (yes/no)

Subjects and Procedures. A total of 157 undergraduate and graduate students participated in the study. The subjects were assigned randomly to one of the four treatment groups that visited the museum during their assigned week or to the control group that did not visit the museum. Subjects were told that this experiment was about the effect of the ambient environment on visitor enjoyment of a museum visit. They were asked to visit the museum any time during the week that they were assigned and just "wander around and have a good time". They could bring a friend if they wished, but not a child under the age of 12. Subjects were told to check in and out at the front desk. When they checked in, they were told by the cashier to be sure to see the bird gallery. When they checked out, the cashier sat them down in an office and gave them the behavior & opinion survey and the quiz. Subjects were asked not to discuss their experiences with their classmates until the end of the quarter. The subjects in the control group were asked not to visit the museum at all that quarter. They were held after class one day during Week One and were given the quiz on the facts on the labels that the other subjects would take. Three weeks after each group visited the museum they took a follow-up test in a classroom setting. This was the same 24 item multiple choice quiz that they had taken at the museum. The control group also retook the quiz three weeks after their original testing.

Results

An initial ANOVA showed significant differences between the treatment groups on both the initial quiz ($F = 15.26$, $p = 0.000$) and the follow-up quiz ($F = 9.26$, $p = 0.000$). A set of orthogonal contrasts confirmed that the Control group scored significantly lower than the four treatment groups on the initial quiz ($t = 7.41$, $p = 0.000$) and the follow up quiz ($t = 5.57$, $p = 0.000$). The Statement group also scored significantly

lower than the three question groups (Implicit, Explicit, Scriptual) on the initial quiz ($t = 2.59$, $p = 0.010$) and the follow-up quiz ($t = 2.28$, $p = 0.024$). There were no significant differences between the means of the Implicit, Explicit, and Scriptual groups on either of the quizzes. A separate ANOVA showed that while the mean scores of all four treatment groups declined significantly from the initial test to the follow-up test, there was not a significant difference in the amount of decline.

Mean Scores for all Treatment Groups on the Initial and Follow-up Quizzes

Treatment Group	Initial Score	Follow-up Score
Implicit	14.0 (58%)	12.6 (53%)
Explicit	14.3 (60%)	12.4 (52%)
Scriptual	15.1 (63%)	14.5 (60%)
Statement	12.2 (51%)	11.2 (47%)
Control	7.2 (30%)	8.1 (34%)

Of the behavior and opinion questions only two were significantly correlated to the quiz scores. Subjects who reported having read more labels scored higher than those who read fewer on the initial quiz ($r = .52$) and the follow-up ($r = .46$). Subjects who gave higher ratings on how "interesting and entertaining" the labels were scored higher on the initial quiz ($r = .35$) and the follow-up ($r = .30$) than those who gave lower ratings. Given these findings it was concluded that posing a question on a label may pique visitors' interest and prompt them to read the label thus resulting in more learning, but further evidence would be needed to show that the question guided the learning process.

Study Two

Goals

The goal of this study was to replicate the question vs. statement findings of Study One under slightly different conditions: instead of comparing subjects who had read only labels beginning with questions to subjects who had read only labels beginning with statements, all subjects would be exposed to an exhibit hall in which half of the labels began with questions and half began with statements. Study Two also controlled for the factor of subject motivation. It was hypothesized that visitors who were cued to study the labels would remember the content of both types of labels equally while the uncued visitors would have better memory of the information from labels that began with questions. Given the results of Study One, no effort was made to create different *types* of questions for the labels.

Methods

Site and Materials. The labels at all ten bird dioramas at the Bell Museum of Natural History were again rewritten, but this time with more input from "visitors" and museum staff. Twelve graduate students visited the museum and listed all the questions they had about the dioramas, then 32 of their classmates then rated the interest level of these questions on a scale of one to five. Eight of the staff at the Bell Museum rated the same questions on a scale of one to five on their appropriateness as topics for labels for the dioramas.

The question for each diorama that rated highest in both visitor interest and staff approval was chosen for the experiment and developed into a label. The question was answered in the first paragraph of the label and the topic was further developed in a second paragraph. Half of the labels were then randomly chosen to be "Statement"

labels and the question title was shortened into a brief descriptive statement. For example, "Do Wood Ducks live in trees?" became "Wood Duck Homes."

A set of "good label criteria" , gleaned from numerous articles on label writing, was created and followed. For a review of the burgeoning literature on how to write good labels, see Mackinney (1993). All labels were 85-100 words long and were written at the 7th or 8th grade level (7.0 - 8.9 on the Flesch Scale). They were printed in the same manner as in study one, but did not include illustrations. Twenty one undergraduate students rated the interest level of the label drafts and the text was revised in response to their comments.

The 30 item multiple choice quiz for this study consisted of three questions from each diorama: one fact from the first paragraph of the label, one fact from the second paragraph, and one item based on visual memory of the diorama. An example of a visual memory item would be:

In the exhibit with a family of wood ducks in a forest, the male Wood Duck was
a. floating in the water.
b. standing next to the female Wood Duck.
c. peeking out of the nest.
d. sitting on a tree branch.

A draft of the quiz was pretested on six adults, revised, and then formally tested on 21 undergraduates to ensure that adults who had not seen the labels scored at chance level on the quiz and that the response foils were chosen with approximately equal frequency.

The following multiple choice behavior and opinion items also appeared on the quiz:

1. Did you visit the museum today alone, or with a friend?
2. Had you ever been to the Bell Museum before today?
3. How often do you usually visit museums?
4. How much did you enjoy your visit at the Bell Museum today?
5. When during your visit did you view the bird dioramas?
6. How many of the labels at the bird dioramas did you actually read?
7. How interesting and entertaining were the labels at the bird dioramas?
8. How much did you know about birds before today?

Subjects and Procedures. A total of 56 graduate students (from a different program than those who had helped create the experimental labels) participated in the main portion of the study. Each subject was assigned randomly to one of the two treatment groups (cued, uncued) that visited the museum. Twenty one undergraduates were used as a comparison group. These students read the label text in a classroom setting and then immediately took the quiz.

The ten experimental labels, half with questions as titles and half with brief descriptive statements, were installed and remained in place throughout the data collection period. Subjects were asked to stop at the admission desk for instructions when they arrived at the museum. Those arriving on even numbered calendar dates were given written instructions to study the labels at the bird displays for a quiz that they would take. Subjects arriving on odd numbered calendar dates were told to "have a good time." All subjects were quizzed just before exiting the museum. There was no follow-up test.

Results

This time the ANOVA showed no significant difference between the learning effectiveness of questions and statements ($F = 1.17$, $p = 0.285$). Surprisingly, the differences between the quiz scores of the cued and uncued subjects were also insignificant ($F = 1.02$, $p = 0.317$) as was the interaction effect ($F = 1.26$, $p = 0.266$).

Scores of Cued and Uncued Subjects on Quiz Items
from Labels with Questions and Labels with Statements

Treatment	Score on Q Items	Score on S Items
Cued	7.3 (49%)	8.1 (54%)
Uncued	7.0 (47%)	7.0 (47%)

However, both cued and uncued subjects scored significantly better on test items taken from the first paragraph of the label than on items taken from the second paragraph or from the visual display ($F = 14.79$, $p = 0.000$).

Scores of Cued and Uncued Subjects on Quiz Items from the
First and Second Paragraphs of the Labels and the Visual Displays

Treatment	Par 1 Items Score	Par 2 Items Score	Visual Items Score
Cued	5.8 (58%)	4.8 (48%)	4.9 (49%)
Uncued	5.8 (58%)	4.1 (41%)	4.2 (42%)

Of the behavior and opinion questions the same number of labels read and interest level were again significantly correlated to the quiz scores. Subjects who reported having read more labels scored higher on the quiz than those who read fewer labels($r = .39$). Subjects who gave higher ratings on how "interesting and entertaining" the labels were scored higher on the quiz than those who gave lower ratings ($r = .30$). Cued subjects did report reading significantly more labels ("a little more than half") than did uncued subjects ("a little less than half") ($t = 2.74$, $p = 0.008$), but did not differ in opinion or behavior from the uncued subjects in any other way.

One explanation for the findings of this study is that the labels used in the second study were too long (100 words as opposed to 50 words in Study One). This conclusion is based on three facts: the cued subjects did not outscore the uncued subjects even though they reported reading more labels, all subjects scored better on quiz items from the first paragraphs of the labels than the second paragraphs, and the subjects in Study Two scored lower than the subjects in Study One.

It is more likely, however, that the above findings were the result of uncooperative cued subjects who read only "a little more than half" of the assigned labels and did not perform any better on the quiz than the subjects who were not expecting to be tested. The study unfortunately coincided with their final exam week, so perhaps the subjects were a bit distracted. To probe this hypothesis 21 undergraduates were asked to try to "beat the scores of the graduate students." They read and studied the label text for ten minutes in a classroom setting and then immediately took the quiz (minus the visual display items). As suspected the comparison group obtained an average score of 17.6 out of 20 (88%) on the quiz compared to the 10.6 out of 20 (53%) for the cued subjects.

Study Three

Goals

The goal of Study Three was to test for an interaction between label length and title type. In a two by two design, long labels (100 words) were installed for one week and short labels (50 words) were installed during the second week. Half of each length of label began with a question while the other half began with a statement. It was hypothesized that subjects who were exposed to the short labels might score better on test items from the labels with questions than on items from the statement labels while subjects exposed to the long labels would not exhibit this difference (mainly because they wouldn't bother to read the labels). However, given the suspicion that the subjects in study two had been unmotivated this was not a strong expectation.

Methods

Site and Materials. The bird diorama labels used in Study Two were slightly modified for use in Study Three as the Long Labels. These labels averaged 94 words in length (range: 90 - 100) and had an average Flesh Grade Point ratings of 7.9 (range: 7.0 - 8.6). Short Labels were created for Study Three by removing information from the long labels. These labels averaged 49 words in length (range: 48 to 50) and had an average Flesh Grade Point rating of 8.2 (range: 7.5 - 8.9). The labels focused on the questions developed in Study Two. Once again, half of the labels were then randomly chosen to be "Statement" labels and the question title was shortened into a brief descriptive statement on both the short and long versions.

A 20 item multiple choice quiz was created to test one fact from paragraph (or sentence) one and one fact from paragraph (or sentence) two of each label. Twenty two undergraduate students and eight adults unrelated to the University pretested the quiz and then rated the interest level of the label drafts. The quiz and label copy were then adjusted accordingly. Several multiple choice demographic, behavior, and opinion items were also included on the quiz:

1. What is your gender?
2. Your age:
3. The highest level of schooling you've completed:
4. Your ethnic background:
5. Where do you live?
6. How many of the labels at the bird dioramas on the 2nd floor did you read?
7. Of the labels you started to read, what portion did you complete?
8. How interesting were the labels at the bird dioramas that you read?
9. Did you prefer the labels that began with questions or with short titles?
10. How long did the labels seem to you?
11. Please write any other comments that you have about the labels here.

Subjects and Procedures. A total of 73 graduate students participated in the main portion of the study. Each subject was randomly assigned to one of the two treatment groups that visited the museum (week one: long labels, week two: short labels). An additional 18 students from the same course acted as a control group by taking the quiz without going to the museum.

The ten long labels, half with questions as titles and half with statements, were installed for one week and then replaced during the second week with the short labels, also half with questions as titles and half with statements. Subjects were instructed to go to the museum during their assigned week and "spend 45 minutes exploring the museum." All subjects were surprised with the quiz at the end of their

visit. To check that they were indeed surprised, the following item was included on the quiz during Week Two of the study:

> Before receiving this survey, did you know that you would be tested on the information presented on the labels at the bird dioramas?
>
> a. I had no clue that I would be tested on anything written on any labels.
> b. I thought I might be tested on something, but I did not know what.
> c. I knew I would be tested on the bird labels because (please explain)

Option "a" was chosen by 28% of the subjects and option "b" was chosen by 72%.

Results

This time the subjects scored significantly better on quiz items taken from labels with questions than on items from labels with statements ($F = 10.42$, $p = 0.002$). However, while subjects in both the Long Labels and the Short Labels treatment groups scored higher than subjects in the control group ($F = 10.91$, $p = 0.000$), the two treatement groups did not score differently from one another and there was no interaction effect between label length and title type.

Scores of Subjects Exposed to Short Labels and Long Labels
on Quiz Items from Labels with Questions and Labels with Statements

Treatment	Score on Q Items	Score on S Items
Long	4.7 (47%)	3.9 (39%)
Short	4.7 (47%)	4.0 (40%)
Control	2.5 (25%)	1.8 (18%)

Once again, subjects scored significantly better on first paragraph items than on second paragraph items if they read long labels and scored better on first sentence items than second sentence items if they read short labels ($F = 10.91$, $p = 0.000$).

None of the responses to the demographic, behavior, and opinion items varied significantly between to subjects who were exposed to long labels and those who were exposed to short labels. However, five of the variables were significantly related to the subjects' total test scores. Subjects who scored higher on the quiz: reported reading more of the experimental labels, reported that they usually read all, rather than just part, of each label, found the labels interesting, had noticed that some labels began with questions while others didn't, and lived in Minneapolis (as opposed to St. Paul or the suburbs). In response to the question on whether the subject preferred labels starting with questions or with statements 44% preferred questions, 21% preferred statements, 20% liked both equally, and 15% said they didn't notice.

Conclusions and Discussion

This series of studies has provided evidence that questions can be used on exhibit labels to increase learning in museums. In both Study One and Study Three visitors had better memory of the information presented on labels that began with questions than labels that did not. This result was obtained when comparing a condition where all the labels in a gallery began with questions to one where all the labels began with brief descriptive titles, as well as under the condition where half of the labels in

a gallery began with questions and half did not. These findings held true for both longer labels and shorter labels.

It is the suspicion of the author that questions on museum exhibit labels serve as attractors and motivators rather than directors of mental processes. This conclusion is based on four pieces of evidence. First, in Study One there was no significant difference in the efficacy of the implicit, explicit, and scriptal questions as had been found in classroom settings. Second, in all three studies the number of labels reportedly read by the subjects was positively correlated to the subjects' text score despite differences in conditions between the three studies. Third, nearly half of the subjects in Study Three reported that they preferred labels that began with questions. Finally, it just makes sense that a well educated adult should be able to remember simple information presented in a clearly written, 50 word passage. This suspicion was confirmed by the comparison group in Study Two.

It may be that the most important factor influencing how much visitors remember form the labels they read is how well the labels are written. Labels that are brief, clear, and entertaining are easy to understand and remember. The question gets the visitor to read the label and learning follows naturally. This is not to say that the little psychological tricks that museum use to attract the visitors' attention to the labels are not important. Attention must be given before learning can occur and questions have proven themselves effective in attracting attention. It is also not to say that all questions are equal. Future studies can explore other typologies to determine which ones are more effective.

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